tion that might be urged on the ground of the charter is wholly academic, for the society cheerfully admits, unmindful of the provisions of the charter, any alien who chooses to apply, and, as the recent ballot has proved, allows him to exercise the *de facto* rights and privileges of a corporator. A British-born woman may at least plead that she, at all events, is a "loving subject." The conflict of legal opinion has made it abundantly clear that there is no practical value in the doubt that has been raised as to the ineligibility of women, but there is absolutely no room for difference of opinion as to the ineligibility of the alien to act as a corporator. Why, then, should the British-born woman be excluded and the alien be admitted? If the alien may vote, why may not the British-born woman?

T. E. THORPE.

The Isothermal Layer of the Atmosphere.

THE point raised by Mr. R. F. Hughes in NATURE of January 21 and February 11 is one that appears to deserve consideration by the investigators of the upper air. He contends, I take it, that even if the instrument records perfectly the temperature of the metal strip, it does not necessarily tell us the temperature of the upper air, but the temperature which the strip takes up in order to bring about a balance between the heat received and lost by it; and in calculating this temperature it is unfair to neglect, without investigation, the absorption and emission of radiation by the instrument and the balloon.

If we take the case of the balloon, in a night ascent, we may write for the time variation of the temperature T of the gas in the balloon, assumed to be a sphere of radius r,

$$\frac{dT}{dt} = -10^{-2}v + \frac{I}{MC} - \frac{4\pi r^2 f\rho v(T-\theta)}{MC} \qquad (1)$$

where v is the upward velocity of the balloon in metres per sec., M is the mass and C the mean specific heat of the balloon and its contents, θ the temperature and ρ the density of the outside air, and f a constant.

The first term represents the rate of decrease of temperature owing to expansion of the balloon.

The second term represents the rate of increase of temperature, assumed to take place uniformly through the balloon owing to the excess, I, of energy absorbed over energy radiated. In the lower layers I is almost certainly very small, and probably negative, but it may not be so at great altitudes.

The last term is an empirical formula to represent the rate of decrease of temperature owing to convection of heat from the balloon by the outside air.

If we assume the atmosphere to be transparent and the earth to be a perfect radiator, and write E for the intensity of its radiation per square centimetre, the balloon receives from the earth energy at the rate $2\pi r^2 E$, of which it absorbs, say, one-half, and transmits the remainder. (A very thin rubber membrane has been found to transmit 75 per cent. of low-temperature radiation.) At the same time, the balloon is radiating in all directions at a rate $\frac{1}{2}.4\pi r^2 B$ approximately, where B is the intensity of radiation of a perfect radiator at the balloon's temperature.

Thus $I = \pi r^2[E - 2B]$.

If the temperature of the earth is 280° A. (=7° C.), then E is about 0·55 gm. cal. per min., and is equal to 2B when the temperature of the balloon is 235° A. If the temperature of the balloon falls to 200° A., $B = \frac{1}{4}E$ nearly and $I = \frac{1}{2}\pi r^2 E$.

I know of no measurements of the rate of convection from a rubber balloon, but a considerable number of experiments have been made to determine this rate for metallic thermometers. According to A. de Quervain (*Beiträge zur Physik der Freien Atmosphäre*, vol. i., p. 192), the value of $f\rho v$ for $v=5$ m.p.s, and $\rho = 1{\cdot}2 \times 10^{-3}$ is roughly equal to 0·1 gm. cal. per min.

The equation (1) therefore reduces to

$$\frac{dT}{dt} = -10^{-2}v + \frac{\pi r^2}{60MC}\left[E - 2B - 0{\cdot}4\frac{\rho}{\rho_0}(T-\theta)\right]$$

if $v=5$ m.p.s. and E, B are measured in gm. cal. per min.

Thus if $\rho = \frac{1}{3}\rho_0$ and $B = \frac{1}{4}E$, T must exceed θ by more than 2° C. if the effect of convection is to exceed that of radiation.

If we take the balloon to be initially of 100 cm. radius, and assume that the heat capacity of the envelope is one-half that of the hydrogen, we have for MC the value

$$1{\cdot}5 \times 3{\cdot}41 \times \tfrac{4}{3}\pi . 10^6 . 8{\cdot}8 . 10^{-5} = \pi \times 600 \text{ nearly},$$

the specific heat of hydrogen being 3·41.

Also r^2 will be 2×10^4, whence $\frac{\pi r^2}{MC} = 33$, and the first term is therefore comparable with the last two in the equation (1). If the temperature is diminishing at the rate of 6° C. per kilometre, T will diminish at the same rate if it exceeds θ by about 1°·7 C. Even if convection is only one-third as efficient as Quervain found, the temperature excess is not more than 5° C.

The thermometers are of bright metal, and even if they are directly exposed to the earth radiation they will not absorb at a rate as great as one-tenth of the rate we have assumed for rubber.

The equation for the temperature variation would be

$$\frac{dT}{dt} = \frac{A[E-2B]}{10MC} - \frac{f\rho v . S}{MC}(T-\theta), \qquad (2)$$

where S is the area exposed to the air current, and 2A the radiating area, which is certainly less than S for a tube thermometer.

If we take Quervain's figures we get A=80 cm.², and $\frac{f\rho v S}{MC} = 8.\frac{\rho}{\rho_0}$ nearly, for a Hergesell instrument, while $\frac{A}{MC} = 160$, so that for T=200° A. we have $\frac{dT}{dt} = 4{\cdot}4 - 2{\cdot}7\ (T-\theta)$, and the excess of T over θ would be but slightly greater than 2° C.

We may, then, take it as certain that the temperatures recorded in night ascents can be but slightly affected by radiation so long as the upward velocity is as great as 5 m.p.s. The assumptions made as regards radiation and convection are, of course, only approximate, but I think they err on the side of exaggerating the radiation effect.

In conclusion, I may add that I undertook this calculation believing that it might be possible for radiation materially to affect the temperature, at least of the balloon, because I knew that even at night radiation from external sources was not insignificant. The result is, however, a complete justification of the instrumental records. The isothermal region exists, and it exists for the very reason which, in Mr. Hughes's opinion, renders useless the instrumental records—the necessity for the material air also to preserve a balance between heat received and heat lost by radiation.

E. GOLD.

Vienna, February 15.

The Promotion of Scientific Research.

PUBLIC attention was directed to the subject of scientific research by the proceedings at the annual meeting of the trustees of the Carnegie Trust, and especially by the prominence given to the promotion of original research in the speech of Mr. Balfour, reported in NATURE of March 4. The reports of the proceedings may have engendered in some minds exaggerated notions as to the extent to which philanthropic effort may succeed in solving the problem of providing incentives to original research. It will be as well, therefore, to mention, for the information of those who are unacquainted with the regulations under which monies subject to the trust may be applied in the promotion of original research, that the incomes of the beneficiaries under the trust are very limited, and the conditions which are specified in the scheme of the trustees are very restrictive. Mr. Balfour, though he spoke encouragingly of the methods adopted by the trustees, alluded to the difficulty and delicacy of the task of selecting people for original work, and to the "puzzling questions of administration" with which it is surrounded; and it seems impossible, without the aid of legislation, to devise any scheme for the application of monies to research purposes which will succeed in inspiring confidence in research workers and which will not greatly restrict the research work which it may be designed to encourage. Had inventors of patentable inventions been encumbered by conditions similar to those to which research workers who are the objects of private munificence are subjected, the progress of inven-

tion would have been immeasurably retarded. The conditions under which the invention of patentable inventions is stimulated do not necessitate an inventor relinquishing the pursuit of any trade, occupation, or profession in which he may be engaged. He is under no obligation to satisfy anyone as to the direction his labours may take, and he is free to devote his talents to the work of invention at such times as he may for himself determine. Moreover, forms of judicial procedure are made available for him by which he can defend his claim to be described as "the true and first inventor" of his invention, whether that be disputed by rival inventors, or opposed on false or fraudulent grounds, or be the subject of official objection.

My scheme for the promotion of scientific research forms the subject of an article in NATURE of January 21. The principles of the scheme, which are generally indicated in the article, admit of substantial grants being made out of public monies for discoveries prescribed by Parliament under conditions analogous to those upon which patents for inventions may be obtained, and these conditions would, it is submitted, enlist in research directed to the making of these discoveries many minds possessing the capacity and true genius for this work, which existing methods wholly fail to attract. Allocations of grants may be made, on the conditions specified in the scheme, to discoveries which advance our knowledge of physical and chemical phenomena, and in relation to the more deadly and prevalent of the diseases which afflict humanity.

Allusion is made in the report of the executive committee of the British Science Guild, of which extracts are given in NATURE of January 28, to the Duke of Devonshire's Commission, which was appointed about thirty-eight years ago to inquire into the means available for extending scientific knowledge and advancing scientific progress. We stand to-day, so far as the provision by the State of pecuniary incentives to scientific research is concerned, much in the same position as we did at the conclusion of the prolonged labours of that commission. Since that time the practical applications of physical, chemical, and medical discoveries, not of a patentable nature, and for which no rewards can under existing conditions be obtained, have greatly contributed to the advancement of commercial and industrial progress and to the national well-being. The discovery of the electric waves used in wireless telegraphy, and of the conductivity of certain substances in the state of powder or filings when these waves impinge upon them, are examples of such discoveries. By means of these two discoveries it was found possible to construct systems of wireless telegraphy. If we confine our attention to the practical applications of these discoveries alone, we must perceive that, in addition to the more general beneficent purposes that have been thereby already attained, they have been the means of greatly increasing the effectiveness of our naval power.

In face of facts such as these, it is to be hoped that our legislators will awaken to a recognition of the momentous issues involved in the promotion of research in departments of science which have an intimate connection with public interests. WALTER B. PRIEST.

1 Verulam Buildings, Gray's Inn, London, March 3.

The "Daylight Saving" Bill.

MAY I point out, in addition to the recognised unscientific nature of the proposals of this Bill, that the third Sunday in April for the putting on of the clocks is hardly consistent with the third Sunday in September for putting them back? The length of the day in the third week of April is considerably greater than in the third week of September, and it would be much more consistent if the two equinoctial months March and September were both adopted for the alteration. The fourth Sunday in March, a little after the vernal equinox, has about the same length of day as the third Sunday in September, a little before the autumnal equinox. If it be urged that the temperature of the air in March in this country is too low for summer habits of life, one may reply that it is still too low in April, and even May, despite the long days and high altitude of the sun. L. C. W. BONACINA.

Northwood, March 13.

Fireball of February 22.

THE observations of this unusual object are exceedingly numerous, but some of them are discordant, and occasion doubts as to the exact path which the meteor traversed in our atmosphere. The radiant point being inaccurately defined, the direction and height are also to some extent uncertain. Apart from the determination already mentioned in NATURE, I have worked out two others, which do not differ very materially except in the elevation at the end. Further descriptions from France of a trustworthy and precise nature will enable the real path over the English Channel to be more certainly ascertained.

Radiant point ...	$= 177° + 13°$ ...	$190° + 20°$
Height at first ...	50 miles ...	56 miles
Height at end ...	26 ,, ...	41 ,,
Length of path ..	155 ,, ...	155 ,,
Velocity per second	25 ,, ...	25 ,,

In the event of the position at $190° + 20°$ being the correct one, the meteor was really a Comæ Berencid, and several fairly good observations from France and the Channel Islands indicate that it is entitled to some degree of confidence. W. F. DENNING.

Bristol, March 14.

Unusual Condition of Nasal Bones in Sphenodon.

IN the osteological collection here there is a skull of Sphenodon with four nasals. In the position of the usual single nasal, right or left, are two bones side by side. As this condition appears to be unusual, it would be interesting to know if any of your readers have come across a similar case. H. W. UNTHANK.

Birkbeck College, Breams Buildings, E.C., March 15.

ENGLISH EARTHWORKS AND THEIR ORIENTATION.[1]

THIS work is based upon the recommendations of the Committee on Ancient Earthworks and Fortified Enclosures. Though "written expressly to further the Committee's aims, it has no claim to be an authorised representation of the Committee's views." Pending the completion of the task undertaken by the Committee, this work seems to be the best text-book on the subject. Though the author has "restricted himself to the discussion of earthworks with which he is personally familiar," all classes of earthworks, from the earliest period to the time of the Civil War, are dealt with.

We are too grateful to the author for the well-sifted materials he has supplied to judge the whole work by any defects, especially if those defects concern matters which the author may have considered as lying outside his proper scope of work. But there is one feature of the author's work which calls for special notice. It concerns a line of inquiry which the author has almost altogether left untried, apparently, but which, nevertheless, he submits repeatedly to the test of ridicule. Though he refers respectfully enough to Sir Norman Lockyer's work, he indulges in remarks about the astronomical inquiry which are both unwarranted and inconsiderate, without showing any appreciation of the points in question.

Beyond some vague remarks about the orientation of amphitheatres (p. 589, note), the subject of orientation is almost entirely ignored. Most of the 224 plans published in the book have the cardinal points indicated, without ever a word saying whether the bearings are magnetic or true. The student of orientation must decide the matter for himself as well as he can in each case with the aid of a protractor. Nowhere can he find the slightest con-

[1] "Earthwork of England: Prehistoric, Roman, Saxon, Danish, Norman, and Mediæval." By A. Hadrian Allcroft. Illustrated with Plans, Sections, &c. Pp. xix+711. (London: Macmillan and Co., Ltd., 1908.) Price 18s. net.